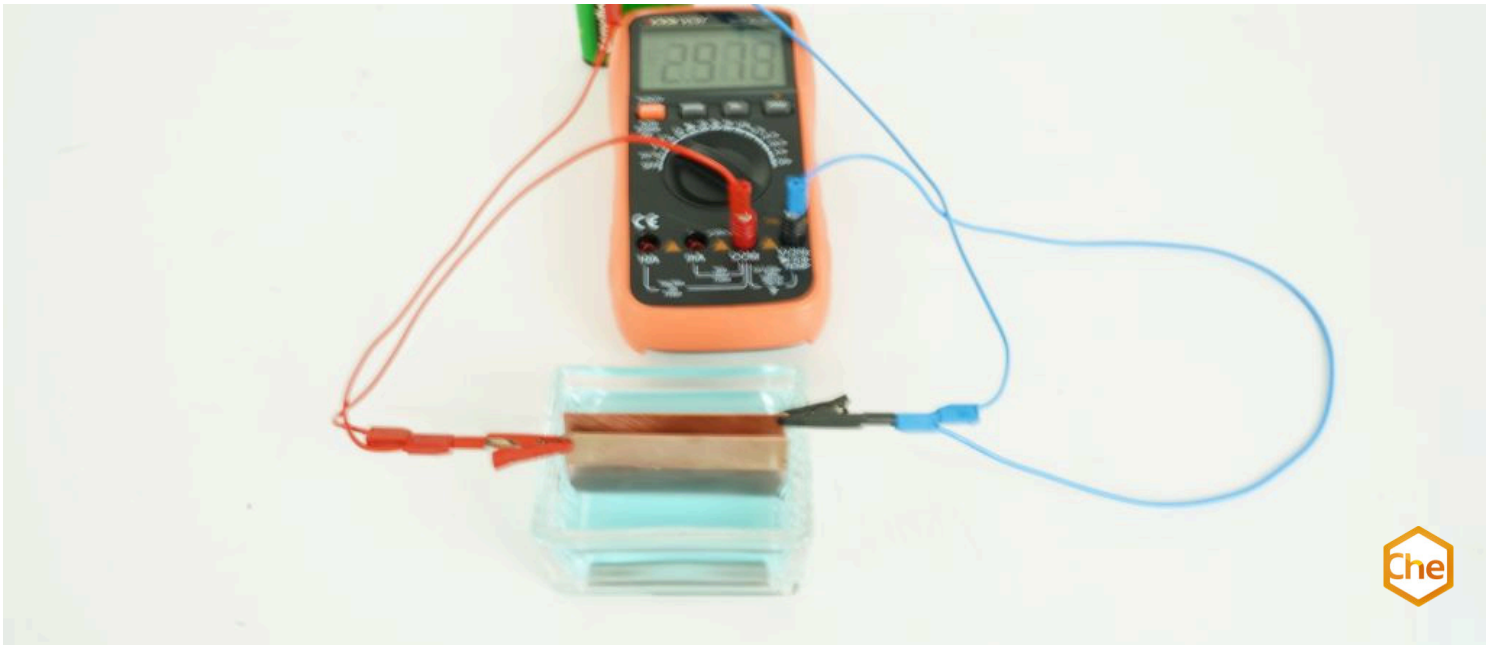
Electrolysis



In this experiment, students investigate the process of an electrolysis.

Chemistry > Physical chemistry > Electrochemistry > Electrolysis

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/61a8c18162271500035bf4d3

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Teacher information

Application

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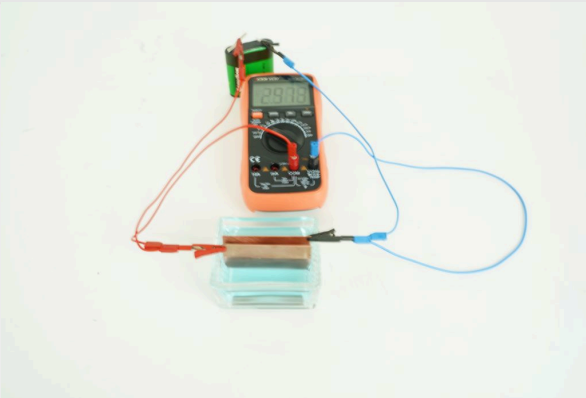

Experiment setup

Electrolysis is one of the main processes for the production of many metals, for example copper or the alkali metals. Electrolysis is a forced redox reaction that takes place with the addition of electrical energy. Generally, a "simple" electrolysis apparatus consists of a DC voltage source, two electrodes and an electrolyte.

In this experiment, the pupils investigate electrolysis using copper as an example. To do this, two (metallic) copper electrodes are immersed in a copper sulphate solution (electrolyte) and connected to a DC voltage source.

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Other teacher information (1/3)

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Previous knowledge

The students should already be familiar with the principle of electrolysis. They should also already be familiar with charge transport, current strength and conductivity.

Scientific Principle

Electrolysis is a redox reaction in which electrons are transferred or withdrawn from one to the other, thus creating the elementary substances. In the process, the electrons flow from the anode to the cathode. The cations from the electrolyte migrate to the anode and take up electrons there, the anions migrate to the cathode and give up electrons.

Other teacher information (2/3)

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Learning objective

This experiment is designed to give students an idea of the many processes involved in charge transport by dissolved ions.

Tasks

The students carry out electrolysis with the grooved trough. The electrolysis bath consists of copper sulphate solution and copper electrodes. They observe visible electrochemical changes in the electrodes and the bath.

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Other teacher information (3/3)

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Further information

- During electrolysis, bubbles can be seen forming on the positive electrode (anode), while copper forms on the negative electrode (cathode).
- Elemental oxygen is formed from the water at the anode and elemental copper from the copper ions at the cathode.
- If the voltage source (battery) is switched off during electrolysis, the finely distributed deposited copper easily falls off the electrode.

Safety instructions

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- Wear protective goggles and gloves.
- For the H- and P-phrases please refer to the corresponding safety data sheets.
- The general instructions for safe experimentation in science lessons apply to this experiment.

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Student Information

Motivation

Aluminium beverage can

You use many metals every day - be it the beverage can, the circuit boards in your computer, the galvanized garden gate. Many of these metals have their origin in electrolysis:

It is one of the main processes for the production of many metals. One of these is aluminium, for example, which is a very important building material for industry due to its low density and simultaneous stability. With the help of a so-called fused-salt electrolysis, the aluminium oxide contained in the naturally occurring bauxite can be reduced to pure aluminium.

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Equipment

Position	Material	Item No.	Quantity
1	Protecting glasses, clear glass	39316-00	1
2	Digital multimeter, 750V AC/DC, 10A AC/DC, 40MΩ, 100mF, 30 MHz, -20...1000°C, Auto range	07123-12	1
3	Connecting cord, 2 mm-plug, 5A, 250 mm, red	07355-01	1
4	Connecting cord, 2 mm-plug, 5A, 250 mm, blue	07355-04	1
5	Connecting cord, 2 mm-plug, 5A, 500 mm, red	07356-01	1
6	Connecting cord, 2 mm-plug, 5A, 500 mm, blue	07356-04	1
7	Copper electrode, 76 mm x 40 mm	45212-00	2
8	Trough, grooved, w/o lid	34568-01	1
9	Flat battery, 4.5 V	07496-01	1
10	Reducing plug 4mm/2mm socket, 2	11620-27	1
11	Alligator clip, insulated, 2 mm socket, 2 pcs.	07275-00	3
12	Copper-II sulphate,cryst. 250 g	30126-25	1

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8	Trough, grooved, w/o lid	34568-01	1
9	Flat battery, 4.5 V	07496-01	1
10	Reducing plug 4mm/2mm socket, 2	11620-27	1
11	Alligator clip, insulated, 2 mm socket, 2 pcs.	07275-00	3

Preparation

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- Clean the two copper electrodes. If necessary, use steel wool or emery paper and scrub them clean.
- If necessary, prepare a copper sulphate solution (picture top right).
  - Add about 0.8 g of copper (II) sulphate pentahydrate (CuSO4 x 5 H2O) to 100 ml of demineralised water.
  - Stir until the powder has dissolved.
  - The water should have taken on a slightly bluish color (picture below right).

Copper sulfate solution

bluish water

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Set-up

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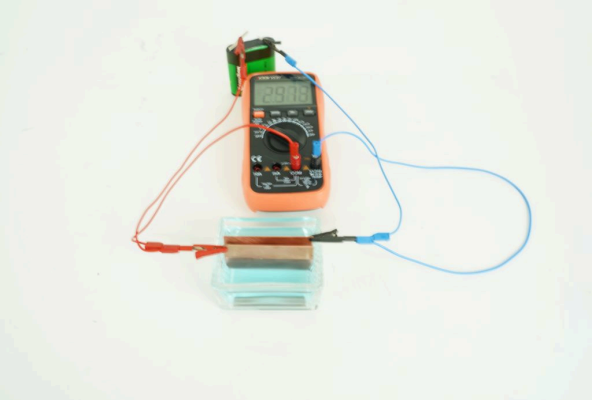
- First mix your electrolyte. To do this, add approx. 85 ml copper sulphate solution and 15 ml sulphuric acid to the grooved trough.
- Now weigh the two copper sheets that act as electrodes.
- Now set up the electrolysis apparatus as shown in the figure on the right.
  - **Don't close the circuit yet!**
  - The electrons and also the alligator clips on the electrodes must not touch each other in the grooved trough, but should be close together.



Experiment setup

Procedure (1/2)

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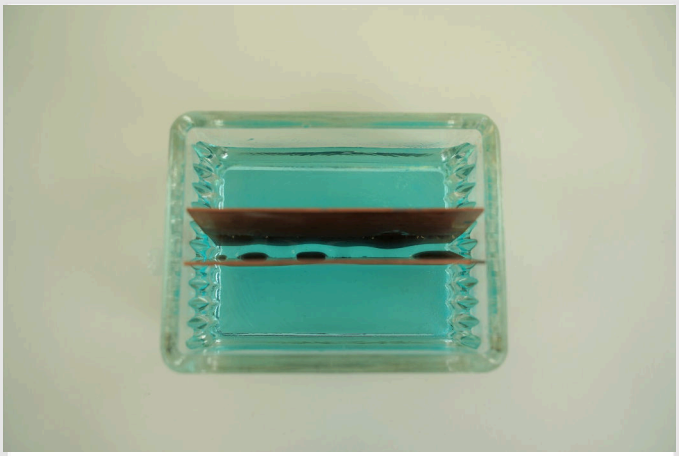
- Close the circuit.
- Make sure that you note which electrode, i.e. which copper sheet, is connected to the positive terminal and which to the negative terminal of the battery. If vapours rise, do not inhale them!
- Turn on the voltmeter and set it to DC voltage.
- Let the electrolysis run for 10 minutes and note the value the voltmeter reads.



The electrodes should not touch each other.

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Procedure (2/2)

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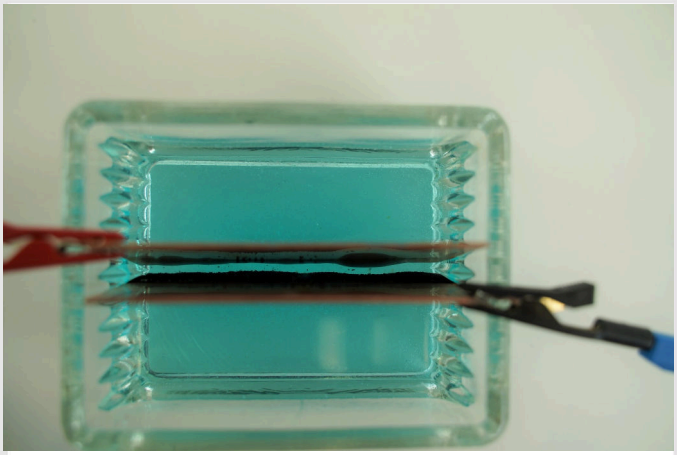
- Stop the electrolysis and wait until the water has cooled down.
- Wash the two electrodes, dry them and look at them closely. What can you determine?
- Write down your observations.



If you look closely, you should see the first gas bubbles between the electrodes.

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Report

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Task 1

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Which statements correspond to your observations?

- [ ] One electrode has darkened after the end of the experiment, the other has become rather lighter.
- [ ] The liquid has become warm during the experiment.
- [ ] Both electrodes are shiny and absolutely clean.
- [ ] During the experiment, air bubbles rose between the two electrodes.

Check

Task 2

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What is electrolysis used for?

- ○ Electrolysis is used to melt metals and cast them into new shapes.
- ○ Electrolysis is used to extract metals, such as aluminium or copper.
- ○ None of the answers are correct.
- ○ Electrolysis is used not only for the extraction of metals but also in mining to dig for ores.

Check

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Task 3

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What exactly happens during electrolysis?

- [ ] Anions from the electrolyte migrate to the positively charged anode.
- [ ] During electrolysis, electrons travel through the electrolyte from the anode to the cathode.
- [ ] Cations from the electrolyte migrate to the negatively charged cathode.
- [ ] None of the answers are correct.
- [ ] During electrolysis, electrons travel through the electrolyte from the cathode to the anode.

Check

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